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Environmental Effects of Dredging Technical Notes

ECONOMIC VALUATION OF WETLANDS

PURPOSE: This technical note summarizes the principles and major issues for the economic valuation of wetlands. The valuation information presented here is intended to support the biological assessment of wetland functions and values as set out in the Wetland Evaluation Technique (WET) (Adamus et al. 1987). Subsequent technical notes will present economic valuation methods for specific wetland services, e.g., commercial fisheries.

BACKGROUND: Wetland biological functions and values, as identified by WET or other wetland assessment, support or provide services that are valued by society. For instance, the functions of Groundwater Recharge and Groundwater Discharge support the Water Supply service. The services provided by wetlands have economic value, if there is a demand for the service, and thus represent a relevant factor for consideration in decisions on wetlands. This economic valuation information provides the rationale for inclusion of economic values in the WET evaluation process.

ADDITIONAL INFORMATION: Contact the authors, Mr. Jim E. Henderson, (601) 634-3305, and Mr. Larry R. Lawrence, (601) 634-2778, or the manager of the Environmental Effects of Dredging Programs, Dr. Robert M. Engler, (601) 634-3624.

Introduction

Wetlands provide a variety of services that are valued by society. The ecological functions and values associated with a particular wetland area may give rise to potential for recreation, wastewater treatment, or residential development services. The services provided by a wetland have economic value to the extent that they provide consumer satisfaction or enjoyment, i.e., provide a desirable service, and are scarce (Loomis and Peterson 1984). The relationship of the biological functions of wetlands, identified by a WET analysis, to the services provided by a wetland is often not well understood or may be highly site specific. Table 1 relates wetland functions and values assessed in WET to services valued by society.

US Army Engineer Waterways Experiment Station
3909 Halls Ferry Road, Vicksburg, MS 39180-6199

Table 1

Services and Supporting Functions and Values

Service:	Residential Location Amenity
Function/Value:	(WET Level 2 Inventory Information)
Service:	Agricultural Development
Function/Value:	(WET Level 2 Inventory Information)
Service:	Water Supply
Function/Value:	Groundwater Recharge
	Groundwater Discharge
Service:	Commercial Harvest of Timber
Function/Value:	(WET Level 2 Inventory Information)
Service:	Wastewater Treatment
Function/Value:	Sediment Stabilization Sediment/Toxicant Retention
	Nutrient Removal/Transformation
Service:	Recreation
Function/Value:	Active Recreation
	Aquatic Diversity/Abundance
	Wildlife Diversity/Abundance
Service:	Erosion Control
Function/Value:	Sediment Stabilization
Service:	Fish and Wildlife Habitat
Function/Value:	Fish Habitat
	Aquatic Diversity/Abundance
	Wildlife Diversity/Abundance
Service:	Sociocultural Values
Function/Value:	Uniqueness/Heritage

Wetland Valuation

Society possesses a number of different notions of the value of natural resources. It is important to clearly define economic value and identify the economic values that valuation in a WET analysis is intended to address. WET was developed to identify and assess the biological and/or ecological functions and values of wetlands. Those functions and values identified in a WET assessment may give rise to services which have economic value. (If there is no service, there is no economic value.)

The total economic value accruing from a resource such as a wetland is determined by society as a whole and so includes a number of different types of economic values. The economic values comprising total economic value include: 1) onsite use values of those persons directly using the resources, e.g. recreator; (2) offsite use values, such as consumers of fish produced from

wetland habitat; (3) future use values, the value of use in the future, and (4) nonuse values, i.e., existence and bequest values (Finch and Bergstrom 1988, Loomis and Peterson 1984). The nonuse values arise from the individual's willingness-to-pay for the continued preservation, and the desire to leave the resources to succeeding generations.

Ideally, consideration of economic values would include consideration of the total economic value. Practically and because decisions are made for specified actions to particular wetland parcels, consideration is usually given only to onsite use values. Depending on the specific action or alteration to a wetland, e.g., wastewater treatment or residential development, only a particular service would likely be valued. The other components of total economic value may also be measured. This statement is made to point out that because of the nature of wetland alteration decisions and limited time and resources for the valuation process, the economic values will normally represent only a part of the total economic value.

Valuation of Wetland Services

Valuation principles

The valuation of wetland services requires comparing the value of services "with" the wetland alteration to the value of services "without" altering the wetland. This with and without valuation principle forms the basis for evaluation of wetlands. The difference in value of the services "with" versus "without" the alteration establishes the value of the wetland, which cannot be done simply by looking at the value of development services. The costs that go into producing the wetland services or developing the wetland are subtracted from the "with" alteration benefits.

The services provided by a wetland and valued by society may be provided by nonwetland resources. A key consideration in valuing wetland services is to determine if substitutes exist for wetland services. Habitat for endangered species may be a service for which there is not a nonwetland substitute, whereas residential development may also occur in fastlands.

Valuation process

The value of the wetland will be the lesser of the direct measure of value of the service(s) provided, such as water supply, or the value considering the costs and benefits of a substitute for the services (Shabman and Batie in

preparation). A generalized valuation process is summarized here. This is adapted from the evaluation frameworks for unaltered and developed wetlands developed by Shabman and Batie.

Valuation of wetland services first identifies the services that are provided by the wetland in question under both the with and without alteration conditions. The service(s) identified are known as the service vector.

Substitutes for the service(s) are identified, if possible. Identification of substitutes can help identify the value of the wetland services. The value of the services provided by a substitute can be used as a proxy value for the wetland service to be lost. The value of wetland services is reflected in the costs of replacing those services with a substitute. It is critical to identify the least-cost substitute in establishing value because, ideally, society would not pay any more than it has to for the services.

Valuation methods for the services are used as described in the following sections to determine values for the wetland services. For services provided by unaltered wetlands, e.g., water supply or flood control, the value is determined by considering what it costs to replace the services such as through structural or engineering measures. For services resulting from the development of the wetland, e.g., residential development, possible substitutes for the wetland must be considered. If no substitutes exist for the wetland services, such as for some endangered species habitat, the value is equal to the wetland development benefits minus development costs. If substitutes exist, the value attributed to the wetland is the difference in value between the wetland development and development of the least-cost alternative.

Measuring Economic Change

The economic change in the value of the services for the with and without conditions can be measured either by determining the total change in economic surplus due to the wetland alteration, or by measuring the marginal value of a wetland acre. These concepts are explained briefly below and are presented here to give the reader a better understanding of the basis of valuation methods. This discussion is not intended to be exhaustive or definitive. There are differing views on the appropriate measurement for economic change in the value of wetland services.

The total change in economic surplus is the sum of the net economic

benefits accruing to the consumers of a service (consumer's surplus) plus the benefits accruing to the producers of a service, the producer's surplus. The total change in economic surplus can be thought of as a measure of how much better off society is due to the wetland alteration. Total change in economic surplus is the appropriate measure when the wetland alteration results in change in the price of a service, due to change in supply and demand resulting from the wetland alteration.

By way of explanation, consumer's surplus is the amount that consumers would be willing to pay above the price of a service. It is surplus or a benefit because the consumer is able to acquire the service at its market value, and the difference between market price and the willingness-to-pay amount is the consumer surplus. The producer's surplus, the net benefits accruing to the producer of the service, is the difference between the per-unit costs of producing the service, i.e., the opportunity costs, and the market price of the service.

Change in economic surplus is the aggregate change, that is, the sum of all the individual changes of producer's and consumer's surpluses. Total change in economic surplus measures the change in economic value resulting from wetland alteration. Because it is a total or aggregate value, economic surplus represents a nonmarginal value, rather than a per-wetland-acre, marginal measure. Total recreation value or average recreation value per user would be determined, rather than recreation value per acre.

The marginal value of a wetland is the economic value of the services gained or lost from the alteration of an incrementally small wetland area (Shabman and Batie in preparation). As Shabman and Batie point out, if a wetland permit decision involves an incrementally small change in total wetland acreage, it is the change in value with an incremental acre versus without the marginal acre development which should be considered. The development of an incremental acre would likely not affect the overall supply and demand function for a service. For example, the loss of an additional acre of wetland commercial fishery hahitat is unlikely to cause a change in the price paid for fish in a fish market.

Marginal values are reported as a value for the service related to an acre of wetland, such as value of shrimp harvest per acre of wetland. In wetland loss in southern Louisiana, there may be a desire to measure reduction in local commercial shrimpers' total revenue caused by wetland loss. The reduction in total revenue would be measured by multiplying the estimated reduction in shrimp

harvest caused by wetland loss by the marginal value (price) of shrimp. The assumption is made that the wetland loss is so small that the aggregate supply curve for shrimp is virtually unaffected, thus leaving the price of shrimp in a store unchanged.

Accounting stance

In considering which measure is appropriate for wetlands, technical and public interest issues should be considered. One consideration is accounting stance. If the interest is in determining contributions to economic well being of the nation, i.e., National Economic Development (NED), then the change in total economic surplus is the appropriate measure (Dwyer, Kelly, and Bowes 1977; Stoll, Loomis, and Bergstrom 1987; US Water Resources Council 1979). Loss of a significant proportion of habitat for a commercial fish species could result in change in overall supply of the fish. In this case, the total change in economic surplus would be important.

If the changes in local or regional economic development are considered important to the wetland evaluation, or if there is concern over income distribution, then marginal values may be the more important measure. Total expenditures and total revenues, for example, are calculated from the marginal value of a wetland service. The loss of shrimpers' revenues stated above is such a use of marginal values. If a permit involves an incrementally small change in wetland area, the marginal value of a wetland acre, measured as the change in total expenditures or revenues, may be significant and of interest from a local or regional economic development perspective.

Further Work

The economic issues summarized here are the basis for valuation of wetlands. A literature review of studies (1970-1985) that valued wetland services has been prepared (Shabman and Batie in preparation) and updated* to identify potential wetland valuation methods that would be used by the Corps. A summary of the review of valuation methods is provided in Technical Note EEDP-06-8. Work has been initiated on guidance documentation for the valuation of wetland services. Guidance will be presented in a series of Technical Notes for the different services provided by wetlands.

* John P. Titre and Jim E. Henderson. "Updated Literature Review of Valuation of Wetlands, 1985-Present," unpublished report, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

References

Adamus, Paul R., et al. 1987. "Wetland Evaluation Technique (WET), Vol. II," Operational Draft, US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Dwyer, J. F., Kelly, J. R., and Bowes, M. D. 1977. "Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development," Research Report No. 128, Water Resources Center, University of Illinois, Urbana, IL.

Finch, R. A., and Bergstrom, J. C. 1988. "Defining the Total Economic Value of a Natural Environment: The Case of Masonboro Island," in: Lyke, W. L., and Bobans, T. J. (eds.), *Proceedings of the Symposium on Coastal Water Resources*, American Water Resources Association, Bethesda, MD, pp 801-809.

Loomis, John B., and Peterson, George L. 1984. "Economic Information in River Recreation Management," *in* Proceedings, 1984 National River Recreation Symposium, October 31-November 3, 1984, Baton Rouge, LA.

Shabman, Leonard A., and Batie, Sandra S. "Socioeconomic Values of Wetlands: Literature Review, 1970-1985," Technical Report (in preparation), US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Stoll, J. R., Loomis, J. B.. and Bergstrom, J. C. 1987. "A Framework for Identifying Economic Benefits and Beneficiaries of Outdoor Recreation," *Policy Studies Review*, Vol 7, pp 443-452.

US Water Resources Council. 1979. "Proposed Rules for Evaluating Benefits and Costs of Federal Water Resources Projects," *Federal Register*, Vol 44, No. 102.